Overview

NASA's Science Mission Directorate (SMD) conducts scientific exploration enabled by the use of space observatories and space probes that view the Earth from space, observe and visit other bodies in the solar system, and gaze out into our galaxy and beyond. NASA's science program seeks answers to profound questions that touch us all:

- How and why are Earth's climate and the environment changing?
- How and why does the Sun vary and affect Earth and the rest of the solar system?
- How do planets and life originate?
- How does the universe work, and what are its origin and destiny?
- Are we alone?

From space, NASA satellites can view the Earth as a planet and enable its study as a complex, dynamic system with diverse components: the oceans, atmosphere, continents, ice sheets, and life itself. The Nation's scientific community can thereby observe and track global-scale changes, connecting causes to effects. They can study regional changes in their global context, as well as observe the role that human civilization plays as a force of change. Through partnerships with agencies that maintain forecasting and decision support systems, NASA improves national capabilities to predict climate, weather, and natural hazards; manage resources; and craft environmental policy.

NASA extends humankind's virtual presence throughout the solar system via robotic space probes to other planets and their moons, to asteroids and comets, and to the icy bodies of the outer solar system. SMD is completing humankind's first basic reconnaissance of the solar system by sending one mission to fly by Pluto and another that will visit two planet-sized asteroids, Ceres and Vesta. SMD is also in the midst of a large-scale investigation of Mars, launching a series of ever more capable orbiters, landers, and rovers, with the long-term goal of a sample return mission and eventual human exploration. In addition, SMD is focusing on certain moons of the giant planets where current NASA missions see intriguing signs of surface activity and of liquid water within, knowing that on Earth, where there is water and an energy source there is also life.

The solar system is governed by the Sun, a main-sequence star midway through its life. The Sun's influence is wielded through its gravity, radiation, solar wind, and magnetic fields, all of which interact with the masses, fields, and atmospheres of planetary and small bodies. Through the eyes of multiple spacecraft, the scientific community sees the solar system as a "heliosphere," another kind of interconnected system with diverse components. Using a fleet of sensors on various spacecraft in Earth orbit and throughout the solar system, SMD seeks to understand how and why the Sun varies, how planetary systems respond, and how human activities are affected. The science of heliophysics enables the space weather predictions necessary to safeguard the outward journeys of human and robotic explorers.

Some of the greatest minds of the last century discovered wondrous things about the physical universe: the Big Bang and black holes, dark matter and dark energy, and the interrelated nature of space and time. Their theories challenge scientists and NASA to use observations from space to test the limits of our understanding of fundamental physics. Having measured the age of the universe, the scientific community now seeks to explore its ultimate extremes: its birth, the edges of space and time near black holes, and the mysterious dark energy filling the entire universe. Scientists also seek to understand the relationship between the smallest of subatomic particles and the vast expanse of the cosmos. With hundreds of planets around other stars now known, scientists are using current NASA

missions in conjunction with ground-based telescopes to seek Earth-like planets in other solar systems.

This is NASA's science vision: to achieve a deep scientific understanding of Earth, other planets and solar system bodies, our star system in its entirety, and the universe beyond. SMD lays the intellectual foundation for the robotic and human expeditions of the future while meeting today's needs for scientific information to address national concerns on global change, space weather, and education.

For over 40 years, NASA has also developed satellites on a reimbursable basis for other civilian Federal agencies. In FY 2012, NASA will continue development of the Geostationary Operational Environmental Satellite weather satellites, the Joint Polar Satellite System weather satellites and ground system, instruments for the Jason 3 sea surface monitoring satellite, and will begin development of the Landsat 9 satellite. These activities are included in the Department of Commerce and Department of the Interior budget requests.

FY 2012 Budget Request

Budget Authority (\$ millions)	FY 2010	Ann CR. FY 2011	Auth Act FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	<u>4,497.6</u>	4,469.0	5,005.7	<u>5,016.8</u>	<u>5,016.8</u>	<u>5,016.8</u>	<u>5,016.8</u>	<u>5,016.8</u>
Earth Science	1,439.3	-	-	1,653.0	1,679.2	1,665.3	1,691.4	1,727.3
Planetary Science	1,364.4	-	-	1,488.9	1,365.7	1,326.4	1,271.0	1,188.9
Astrophysics	647.3	-	-	637.7	708.3	721.0	713.5	741.9
James Webb Space Telescope	438.7	-	-	354.6	359.3	365.3	371.6	371.6
Heliophysics	608.0	-	-	577.9	591.0	612.4	627.2	628.6
SCMD Civil Service Labor and Expenses	0.0	-	-	304.7	313.2	326.5	342.2	358.6

Note: The budget request table reflects the elevation of the James Webb Space Telescope to a separate theme within SMD, rather than a project within the Astrophysics theme.

The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended). Amounts in the "Ann. CR FY 2011" column reflect the annualized level provided by the Continuing Resolution.

The "Auth. Act FY 2011" column represents FY 2011 authorized funding from the NASA Authorization Act of 2010 (P.L. 111-267).

In accordance with the President's proposal to implement a five-year non-security discretionary spending freeze, budget figures shown for years after FY 2012 are notional and do not represent policy. Funding decisions will be made on a year-by-year basis.

Plans for FY 2012

Science

Earth Science

New Initiatives:

No new initiatives are included.

Major Changes:

Continued funding for the global climate initiative, a major addition in the President's FY 2011 budget proposal, is included at a reduced level.

Major Highlights for FY 2012

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) is scheduled to launch in early FY 2012, continuing selected climate data records and becoming an integral part of the Nation's operational meteorological satellite system for weather prediction.

Release of the second Venture Class Announcement of Opportunity in FY 2011 will lead to selection of new science instruments and small missions in FY 2012.

The Glory mission will release its first global set of calibrated and validated aerosol measurements. The first A-Train fusion data products integrating Glory data with measurements from the rest of the A-Train will be produced.

The Aquarius instrument on the Argentine SAC-D mission will deliver its first global ocean salinity measurements to the science community.

The Orbiting Carbon Observatory 2 (OCO-2), Landsat Data Continuity Mission (LDCM), and the Global Precipitation Measurement (GPM) missions will be conducting integration and testing, in preparation for planned launches in FY 2013.

The first two decadal survey missions, Soil Moisture Active/Passive (SMAP) and the Ice, Cloud, and land Elevation Satellite-2 (ICESat-2), will both enter into development.

The budget supports robust Research and Analysis, Applied Science, and Technology programs.

Planetary Science

New Initiatives:

No new initiatives are included.

Major Changes:

There are no major programmatic changes. In early 2011, NASA is expecting the results from the next National Academies' Decadal Survey for Planetary Science. This may lead to changes in planning and preparation for next year's FY 2013 budget proposal.

Major Highlights for FY 2012

The Mars Science Laboratory (MSL) will launch in early FY 2012 and arrive at Mars in August 2012.

The Juno mission, following launch in August 2011, will continue towards arrival at Jupiter in 2016.

The Gravity Recovery And Interior Laboratory (GRAIL) mission, following launch in September 2011, will enter lunar orbit and complete its prime mission. GRAIL will help determine the structure of the lunar interior from crust to core, and advance understanding of the thermal evolution of the Moon. As a secondary objective, GRAIL will enable scientists to extend knowledge gained from the Moon to the other terrestrial planets.

The MErcury Surface, Space ENvironment, GEochemistry and Ranging (MESSENGER) mission will complete its first year in Mercury orbit in March 2012. MESSENGER's instruments will map nearly the entire planet in color, image the surface in high resolution, and measure the composition of the surface, atmosphere, and nature of the magnetic field and magnetosphere.

The Discovery Program supports low-cost missions that enhance our understanding of the solar system by exploring the planets, their moons, and small bodies such as comets and asteroids. Following a Discovery Announcement of Opportunity released in June 2010, and a step 1 or concept study selection in early 2011, NASA will make final mission selection(s) in the summer of 2012.

The budget supports robust Research and Analysis and Technology programs.

Astrophysics

New Initiatives:

No new initiatives are included.

Major Changes:

The budget for the James Webb Space Telescope (JWST) is now carried under its own Theme. This is consistent with management changes implemented in FY 2011 to improve management oversight and control over the project, following release of the Independent Comprehensive Review Panel's (ICRP) report in November 2010.

The budget reflects the scientific priorities of the National Academies' decadal survey for astronomy and astrophysics. Specifically, early technology funding for missions beyond JWST is included, while work on the Space Interferometry Mission (SIM) and Joint Dark Energy Mission (JDEM) has been terminated. The budget includes additional funding for the Explorer mission selection planned for 2012, and increased investments in research and technology as recommended by the decadal survey.

Major Highlights for FY 2012

The Stratospheric Observatory For Infrared Astronomy (SOFIA) will complete its open door flight testing and conduct the first competed science observations.

The Nuclear Spectroscopic Telescope Array (NuSTAR) mission will launch in early 2012.

The budget supports robust Research and Analysis and Scientific Balloon programs.

James Webb Space Telescope

New Initiatives:

No new initiatives are included.

Major Changes:

JWST was elevated to its own Theme to reflect management changes implemented in FY 2011 to improve oversight and control over the project in response to the release of the Independent Comprehensive Review Panel's (ICRP) report in November 2010. The project, which was previously managed within the Science Mission Directorate's Astrophysics Division within NASA Headquarters, as part of the Cosmic Origins Program, is now managed via a separate program office also at NASA Headquarters. The Program Manager of JWST at Headquarters now reports directly to NASA's Associate Administrator and the Associate Administrator of the Science Mission Directorate (SMD). The lead Center for developing JWST, Goddard Space Flight Center (GSFC) has also implemented changes, with project management now reporting directly to the Center Director.

Note that the technical content of the JWST project has not changed as a result of any of these management changes, and in fact the changes have been made in recognition of the high importance of this mission for the Agency and the astrophysics community.

Major Highlights for FY 2012

JWST was again included as a high priority in the most recently released National Academies decadal survey for astronomy and astrophysics entitled "New Worlds, New Horizons in Astronomy and Astrophysics" (National Academies, 2010). The project remains an integral part of the Science Mission Directorate's portfolio of bold new Astrophysics initiatives that open the universe to reveal new discoveries. JWST was the top priority of earlier decadal surveys, and helps to provide the foundational science upon which the new projects of the latest survey depend.

During 2010, JWST identified cost growth and schedule issues, which resulted in the formation of the Independent Comprehensive Review Panel (ICRP). The ICRP charter was to determine the technical, management and budgetary root causes of cost growth and schedule delay on JWST, to estimate the minimum cost to launch JWST, and to assess the associated launch date and budget profile. The ICRP report concluded that the problems causing cost growth and schedule delays on the JWST project are associated with cost estimation and program management. The panel recommended several managerial changes at Headquarters and GSFC, and some of these have already been implemented. The JWST project budget and schedule will be re-evaluated as part of a re-planning activity and a new plan is expected in 2011. The results of this re-planning activity will be presented to Congress immediately upon completion of the work. In addition, NASA will keep Congress apprised of progress during development of the new baseline.

Heliophysics

New Initiatives:

No new initiatives are included.

Major Changes:

Funding for the next Explorer mission selection, planned for 2012, has been increased to enable selection of up to two full missions, as well as (potentially) instruments to fly on non-Explorer spacecraft. Half of the available funding has been transferred to the Astrophysics Explorer Program, reflecting the potential selection of one full mission from each Theme.

Major Highlights for FY 2012

The Radiation Belt Storm Probe (RBSP) mission will launch.

The Solar Probe Plus mission will enter into preliminary design (Phase B).

The budget supports robust Research and Analysis, and Sounding Rocket operations programs.